# Estuary, Foreshore and Water Log Handling and Transportation Study

SUMMARY REPORT OF THE
STEERING COMMITTEE

JULY, 1981

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# ESTUARY, FORESHORE AND WATER LOG HANDLING AND TRANSPORTATION STUDY

Summary Report of
the Steering Committee

July, 1981

This report represents a cooperative effort of the governments of Canada and British Columbia and the Council of Forest Industries of B.C.

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1500-1055 West Hastings
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## PREFACE

In the fall of 1979, the President of the Council of Forest Industries, the Federal Minister of Fisheries and Oceans and the Provincial Minister of Environment announced a joint study of the interrelations between water log handling and other uses of estuaries and nearshore marine areas on the British Columbia coast.

This report provides a summary of the work undertaken under the guidance of a Steering Committee comprised of representatives of the coastal forest industry and the federal and provincial governments. It is based on extensive background material provided by consultants under contract to the Committee as well as drawing on the expertise available in the organizations of Committee members. The contributions of the consultants and staff who assisted in the preparation of the background reports is gratefully acknowledged. Readers seeking more information are encouraged to refer to documents listed in Appendix III.

This summary is not a policy statement of industry or of government, and does not give final answers to problems now being faced. Rather it outlines the range of factors that must be considered in reviewing interactions between log handling and the environment. This report provides a set of conclusions and recommendations based upon the analysis undertaken as a part of this coast wide review.

In preparing this summary, the Steering Committee has chosen to address the interested public, as well as those whose work involves them actively in interests associated with the use and management of coastal shores and waters. The Steering Committee recognizes that a well informed public will greatly assist in the consideration of current and future uses of these significant areas.

## A. INTRODUCTION

Coastal British Columbia has a rich array of natural resources. It is the most productive commercial forest area in Canada. Its marine waters and rivers provide for an extremely important commercial fishery as well as significant sports fishery. In addition to diverse resident wildlife and marine mammals, several millions of waterfowl, shorebirds, and other migratory birds from three continents visit estuaries and other coastal habitats each year. Sheltered waters, scenic beauty, and a moderate climate combine with a growing economy to attract more and more people to Southern Vancouver Island and the Lower Mainland. Associated with this growth there is competition among users for the favored sites, particularly accessible shores. The mountainous coast makes roads and rail lines difficult to build. Consequently the forest industry is forced to use coastal waters for storage and transportation of its logs. The industry grew and is dependent upon the availability of water transportation for raw materials and finished products.

During the late 1960's and through the 1970's, concern mounted over the effect of development on the ecosystems of estuaries and nearshore marine areas. Human activities such as urban growth, industrial development, port development, agriculture and recreation may have adverse effects on shore environments. The effects of these uses on environmental quality and productivity have become a source of growing concern. Specifically, traditional shore uses for log handling and transportation have come under greater scrutiny. In response to this situation, over a decade ago the coastal forest industry began to reconsider its approach to handling and transporting logs on the coast.

The coastal forest industry will continue to depend on waterways but techniques for handling and transporting logs are changing. Dryland sorting, bundle booming and barge transport were introduced to achieve greater economies, to reduce the loss of logs and to alleviate environmental problems. Although the industry has made many improvements in environmental management, problems persist in areas where it is constrained by topography, prior investment and operational patterns. Thus, strategies for dealing with problems between these industrial activities and other uses is the prime focus of this report.

## B. BACKGROUND AND APPROACH

Basic questions had been raised about whether log dumping, sorting and storing activities can coexist with fish, shellfish, birds, marine life, or marshlife without significiant loss of productivity. There were also concerns about the compatibility of coastal recreation and forest industry activities. Questions were being raised about whether one use of nearshore areas produces greater benefit to society than another and should therefore take primacy. The limited information that was available to answer these questions was being interpreted differently by various analysts, and there was a growing concern that interpretations were being biased in favor of whatever side of an issue one supported.

In early 1979, the Council of Forest Industries of B.C. (COFI) began to explore the possibility of having an independent review of available quantitative data to answer these questions. They soon found that federal and provincial government agencies were equally interested in reviewing the interface between coastal log handling and other primary users in order to establish a common approach to resolving conflicts in resource utilization. In September 1979, a Steering Committee, with representatives from provincial and federal government agencies, as well as from industry, was formed to commission and supervise a series of studies to examine the interface between log handling and other uses of coastal B.C. waters. From the outset, all members of the Steering Committee considered it essential that interactions between the environment and log handling and transportation be reviewed by independent analysts. The Steering Committee's program consisted of three components:

1. Environment
2. Log Handling
3. Recreation

The Environmental Component was coordinated by an Environmental Review Panel of specialists who developed the terms of reference for their consultants. The Steering Committee arranged a contract with COFI, the federal, and the provincial governments each contributing one third of the cost.

The Log Handling Component was established to determine current log handling use of areas on the coast and to provide a projection of future requirements. A Review Panel (comprised of industry and government representatives) prepared terms of reference for the log handling studies, the results of which were analyzed by the Forest Engineering Research Institute of Canada.

A study of recreational uses was undertaken by the provincial government and presented to the Steering Committee. The Recreation Component established a three-person Review Panel drawn from government, industry and the University of British Columbia. The Panel commissioned consultants to describe the resource base for water-oriented recreation on the coast.

Environmental regulation of the coastal forest industry, while not a detailed focus of the Steering Committee's program of background studies, was the subject of a major study by the Westwater Research Centre at the University of British Columbia for the Economic Council of Canada. Some of the conclusions of this study are referred to in this report. In addition, the Ministry of Lands, Parks and Housing, as a parallel activity, prepared Interim Guidelines for Review and Processing of Coastal Log Handling Applications with the intent that these would be finalized on completion of the Steering Committee's report.

In addition to the work undertaken by consultants, members of the Steering Committee also have drawn on their own expertise and experience as well as that of staff in their organizations to augment this report. As such, the report contains an amalgam of sources too numerous to credit in the short space of a summary.

Throughout the report reference is made to a variety of uses of B.C.'s foreshores, estuaries and nearshore marine areas. In doing so the Steering Committee has endeavored to provide direction to minimize the conflicts among various users. No attempt was made to give priority to any use.

## C. ENVIRONMENTAL RESOURCES IN FORESHORE HABITATS

### Fisheries

Marine, estuarine and freshwater shore zones in British Columbia directly and indirectly support very significant stocks of commercially and recreationally valuable fishes. The biological productivity of these zones is influenced by a complex of factors, processes and characteristics, including topography and geology. Stocks utilizing these zones exhibit a diversity of requirements. The combination of productive potential and related requirements determines the nature and intensity of use and, accordingly, the importance and sensitivity of a given zone in terms of the integrity of individual stocks, and the total fishery resource. Other factors such as harvesting rates and stream habitat conditions also have a bearing on the total productivity of resources. In view of the focus of this report on shore zones, no further mention of these factors is made in this report.

An increasing volume of data originating from fundamental research and stock management studies and site specific investigations associated with foreshore use proposals or activities has provided a clearer perspective of the role of shore zone ecosystems in the life cycles of salmon, herring and shellfish. While knowledge is far from complete, there are a number of characteristic features of these highly utilized areas which contribute to productive potential. Among the most important are shelter, a relatively wide range of physical and chemical conditions (exemplified in estuaries) and availability of food delivered by tide and currents and produced in a stable and perpetuating ecosystem.

#### Fish

Salmon, steelhead and cutthroat trout, herring, smelt, sturgeon, shellfish and crabs are all dependent on the quality of British Columbia's foreshore environments for all or portions of their respective life cycles. The magnitude of these fisheries stocks is reflected by the commercial, recreational and native food fish catches. The 1975-1979 average annual commercial and native food fish harvest of salmon, herring, eulachon, crabs and shellfish was approximately 56 500, 73 700, 31, 1 100 and seven tonnes respectively. In addition, the recreational fisheries took an estimated 1.5 to 2.0 million salmon and 1.6 million shellfish in 1979.

Although the life cycles of the five species of Pacific salmon, commonly called sockeye, coho, chinook, chum and pink vary considerably, they have several common characteristics. All species reach maturity in the ocean and return to their "home" streams and lakes in the summer and fall to spawn and die. Steelhead and sea-run cutthroat trout also mature in the ocean and return to spawn in fresh water.

Pink and chum salmon fry which migrate seaward soon after they emerge from the spawning gravel, feed for variable lengths of time in estuarine and nearshore marine environments. Chinook remain to rear in their native stream systems for about three to twelve months before seaward migration. Present information indicates that these races in which the shorter freshwater rearing period predominates, commonly remain in intertidal estuarine and marine nearshore environments for one to five months before assuming a pelagic marine existence. Yearling chinook do not appear to remain in intertidal estuarine areas for extended periods. Coho remain to rear in their native freshwater systems for a full year before migration. The evidence from several major estuary studies indicates that coho yearlings may use estuarine habitats throughout the year. Recoveries of tagged fish have also shown that chinook and coho juveniles occupy estuaries distant from their natal streams. During estuarine residency, juvenile chum, pink, coho and chinook salmon feed extensively and in some instances, exclusively, upon invertebrates and larval fishes which are indigenous to these environments. Most sockeye fry migrate from stream spawning areas to lakes where they remain to rear for one to two years, before migrating to the sea. With minor exceptions, the evidence indicates that juvenile sockeye do not utilize the intertidal estuary or nearshore marine areas following downstream migration.

Mature steelhead and cutthroat may spawn more than once and return to the sea after spawning. The juveniles of these species remain for one to three years in freshwater habitats whereupon they migrate to the ocean. Evidence of spring feeding migrations and juvenile residency indicates that cutthroat are more estuarine-dependent both as juveniles and maturing adults than steelhead.

Smelt and herring migrate on to the shore zone to spawn during the winter and early spring. Major populations of anadromous smelt (eulachon) return from the sea in early spring to spawn in the lower reaches of many of the major rivers of coastal B.C. They deposit their adhesive eggs on the sand and gravel of the river bottom to depths of 8 metres and die. The eggs hatch in a few weeks and the weak-swimming larvae drift passively downstream to the estuaries and ocean.Other smelts migrate to the shore zone to spawn during the winter and early spring. These smelt select intertidal sand and gravel beaches where their eggs are broadcast and become buried by tidal movement. The young apparently move away from the shore zone soon after hatching.

Herring select intertidal and subtidal areas characterized by beds of eelgrass, kelp and fucus upon which their adhesive egg masses cling. The eggs hatch in a few weeks and the young remain in nearshore marine and estuarine environments for variable periods, feeding largely on plankton.

Sturgeon are widely distributed along the coast and ascend the major river systems to feed and spawn. Commercial and sport fishing catches indicate that intertidal riverine habitats are utilized by a wide range of age classes.

Shellfish

Several species of edible clams and related animals are found in the intertidal sands and sediments, common to the bays, estuaries and inlets of the B.C. coast. Their relatively sessile existence and simple reproductive cycle combine to render them highly vulnerable to changes in their environment.

The Pacific oyster grows most productively on lower intertidal flats characterized by small stones, cobbles and shells upon which they are anchored. Their reproductive cycle peaks in later summer and the larvae drift passively in the ocean currents for a short period before actively selecting their individual growing sites.

Crustaceans

Dungeness crabs constitute the major commercial and recreational species in coastal British Columbia. Adult crabs are most abundant on the lower intertidal sand and mud flats and along the delta front and continental shelf commonly to a depth of 90 metres. Spawning takes place in the summer, and the free-swimming, pelagic larvae drift with the ocean currents for several months before changing form and occupying the intertidal and subtidal shore zones characterized by sand, eelgrass and other marine plants to a depth of 10 meters.

Marine Mammals

The extensive array of rocky shores, active beaches, pocket coves, and sheltered bays of British Columbia are biophysical features suitable for a large variety of marine mammals. The major species with nearshore needs include: the harbor seal, sea-lion, killer whale, otter and mink.

Harbor (fur) seals occur along the entire B.C. coast and coastal islands. They frequent water close to shore and are seen in shallow bays and inlets to a far greater extent than other seals. Exposed rocks and sandbars are their favourite haul-out places. Their food is made up entirely of fish and shellfish.

Northern (stellar) sea-lions are frequently found on and around certain rocky islets along the entire B.C. coast - notably Scott Island, Price Island, Cape St. James. In summer, these large rookeries harbor thousands of sea-lions. In winter, sea-lions are often seen in bays, river estuaries, and channels. Their food consists largely of fish. Other species of the same order found in B.C. include the California sea-lion and Northern fur-seal.

The killer whale is the most abundant whale in British Columbia's coastal waters, although the estimated population is less than 300 animals. They commonly inhabit inlets and bays, feeding on a variety of fish and marine mammals. Certain key locations along the coast provide special places for resting, mating and other social activities.

Otters are abundant on the B.C. coast and among the offshore archipelagos. Two species can be found - the river and sea otters. The latter is a less common species and resides solely at sea. Crabs, molluscs, sea-urchins, and fish are the preferred foods of otters.

Mink can often be found among rocks and logs of the coast feeding largely upon marine crustaceans, shellfish and fish.

Birds

The avian component of British Columbia's estuaries and nearshore ecosystems is both varied and abundant. No season of the year on the lower coast is without its regular visiting groups or species. Some arrive in spring to nest, rear young and depart in the fall as other groups arrive to spend the winter. Many are spring, summer or fall migrants and are seen only in passing.

Aquatic birds which frequent protected waters along the British Columbia coast, include divers (loons, grebes, cormorants, alcids), waterfowl (swans, geese and ducks) and gulls. Estuaries and sheltered coastal waters provide essential wintering and staging habitat for large numbers of waterfowl, shorebirds and migrants on the Pacific Flyway. Use of coastal environments for these activities is highest during the period from October to April.

The habitat requirements of aquatic birds vary from species to species, however, there are some important common characteristics. For example, aquatic birds in British Columbia are generally found on waters of less than 10 metres in depth. Although seasonal and regional differences in the food requirements of most aquatic birds are poorly documented, bottom-dwelling fish and benthic invertebrates are known to be important food items for diving ducks and gulls, while grazers such as brant and geese feed extensively on eelgrass.

The marshbird and shorebird group includes the long-legged, shallow-water waders (herons and bitterns) and the smaller shorebirds (sandpipers, plovers and others). Generally, great blue herons and the smaller shorebirds utilize similar feeding habitat and are found most often on the broad intertidal areas and the wet riparian meadows.

A large songbird group contains many species which are widespread throughout a variety of habitats. These species are difficult to assess in terms of numbers and their use of estuaries. It is unlikely that many species of songbirds visit the exposed intertidal flats, but any areas of emergent vegetation and riparian tree/shrub communities are extensively used.

Raptors require abundant prey species, large open areas for easy hunting, and vegetation for perching, nesting and cover. These species use the upper reaches of the intertidal area, meadows and fields primarily as hunting grounds where prey species are readily available. For example, peregrine falcons, gyrfalcons, goshawks and merlins are attracted by the large numbers of waterfowl and shorebirds. Other hawks and most owls are attracted by the abundant supply of small rodents on the upper fringes of the foreshore and the fields nearby.

Marine Plants

The abundance of animal life in an area largely depends in some complex fashion upon the availability of plant matter to supply nutrients (energy) and to provide shelter and substrate requirements. In nearshore areas the common types of marine plants include seagrasses, seaweeds, and phytoplankton.

Seagrasses and seaweeds are commonly found in shallow coastal waters. Their physical presence often creates a habitat for a large number and variety of marine organisms. Juvenile and adult fish, crustaceans, and molluscs frequently inhabit these areas of plant growth for refuge, spawning, or feeding. Eelgrass, for example, is commonly used as a substrate for the deposition of herring spawn and provides shelter for juvenile fish and crustaceans. Extensive kelp beds and other types of hold-fast seaweeds also create similar habitat needs for other forms of marine life by reducing wave surge and by stabilizing bottom substrates.

Phytoplankton are single-celled algae which provide an essential link in the food chain for many forms of marine life. They, along with seagrasses and seaweeds, produce food energy through photosynthesis and the uptake of dissolved inorganic substances. This energy is the base of food chains and is commonly known as primary productivity.

Research Priorities

The shortfall in knowledge of foreshore ecology has been the subject of research in recent years. These studies have been strongly guided by the types of shore areas most frequently subject to human modification, perceptions of their importance to valuable species, available expertise, and degree of manageability of potential problems. Research has therefore been directed to: (i) determining whether and where sensitive life history stages of important species and their food web components occur in shore zones, (ii) documenting the types of use made of estuaries and shore zones by fish, (iii) identifying the shore zone features essential for use by fish such as food availability, physical, chemical, hydrological, oceanographic, and sedimentary characteristics, as well as vegetational factors, and (iv) investigating the means and opportunities for restoration and development of foreshore and estuarine habitats.

Immediate research priorities currently include: (i) compilation, synthesis and analysis of existing regional data from all sources, (ii) a five year program of specialized work on residency, growth and mortality of important species in selected shore habitats as compared with those forced to utilize alternate habitats; (iii) shore habitat improvements, restoration and development projects, including intensive evaluation; (iv) further investigation of the role of shore vegetation and other nutrient inputs in supporting resource species and food web components in nearshore areas; and (v) development of methods for assessing impacts of the cumulative effects of incremental shoreline degradation on fisheries yields. Added to these basic research priorities is the need for information on direct and indirect relationships among habitat productivity, resource population levels and various types of influences on these habitats and populations.

## D. LOG HANDLING AND TRANSPORTATION

The forest industry has developed on the coast of British Columbia over the past one hundred and twenty years. During this period the annual harvest has reached 31 million cubic metres of logs, a level which is expected to be maintained into the future. Conversion plants were developed in areas that had favorable climates, flat land, access to timber supplies, continental rail links and deep-sea terminals. Consequently, there is a heavy concentration of mills on the lower mainland coast and southern Vancouver Island. Harvest areas which initially were close to the mills now extend along the entire mainland coast and over most of Vancouver Island as well as to the Queen Charlotte Islands and numerous smaller islands. These supply areas are separated from milling centers by a mountainous, fjord-dissected coast and open water, which severely limits land transportation. Water log handling and transportation is therefore the vital link between the harvesting areas and the consuming mills.

### Log Production and Consumption

The pattern of coastal log production and consumption is stabilizing and there are predictable trends. Table I shows these patterns and trends. Log production is expected to increase on the north coast, Queen Charlotte Islands and west coast of Vancouver Island. This increased production will be offset by declines in the southern areas of the coast resulting in little or no increase in production in the foreseeable future. Log consumption will remain relatively stable and 68 percent or more of the harvest will be consumed in the southern Vancouver Island, Howe Sound and Fraser River areas. As a result of these patterns, the dependency of the coastal forest industry on the coastal waterways will continue.

Table 1

Log Production and Consumption by Area
Coastal British Columbia, 1979

| | Production | | Consumption | |
|---|---|---|---|---|
| | Current (percent) | Trend | Current (percent) | Trend |
| North Coast & Queen Charlotte Islands | 15 | Up | 5 | Level |
| West Coast Vancouver Island | 15 | Up | 7 | Level |
| Northeast Vancouver Island and Mainland | 37 | Down | 9 | Level |
| Alberni | 10 | Level | 11 | Level |
| Southern Vancouver Island | 15 | Down | 29 | Up |
| Howe Sound, Fraser River | 8 | Down | 39 | Level |
| TOTAL | 100 | | 100 | |

(Based on an annual volume of 31 million $m^3$ of logs)

SOURCE: After Boyd, Kenneth G., Water Transport of Wood: B.C. Coast.

Foreshore Leases

Historically, log handling activities have been carried out on foreshore areas under lease from the provincial government and various harbor commissions. These activities continue today and are still performed on foreshore lease areas. Due to competing demands from other uses, the forest industry is facing pressure in finding and retaining suitable foreshore areas for efficient and economic operations. As the forest industry is forced to vacate areas historically used for log handling, pressure for leases in alternate areas is increasing.

The forest industry's present and future foreshore lease requirements are summarized, with reference to Figure 1 and Table 2. Based on this information, log handling uses of the foreshore occupy 8957 hectares, of which 2260 hectares are primarily marine intertidal, 1119 hectares are estuarine and 1200 are riverine. While these areas are relatively small compared to the total coastal area in each category, a high concentration of these leases occur on southeastern Vancouver Island and in the Howe Sound/Fraser River area. It is estimated that existing leases will decline by 1181 hectares or 13 percent by the year 2000. As new logging areas are developed an estimated 3030 hectares of new foreshore leases will be required. The changes result in a net increase of 1849 hectares of foreshore leases by the year 2000.

Based on these projections the greatest lease area expansion will occur on the northwest coast of Vancouver Island (Region 11) and the north mainland coast. A net increase of 495 hectares is expected to occur in the south mainland coast and southern Vancouver Island areas (Regions 1 to 6, 8, 9, 12, in Figure 1) where the conflicting pressures for foreshore use are most acute.

These changes in foreshore lease requirements are based on current log handling technology, and do not reflect the level of activity on leases which varies considerably from continuous use to no use for periods of several years. The point is that lease area requirements are not static. For example variations will result from seasonal operations,

Table 2

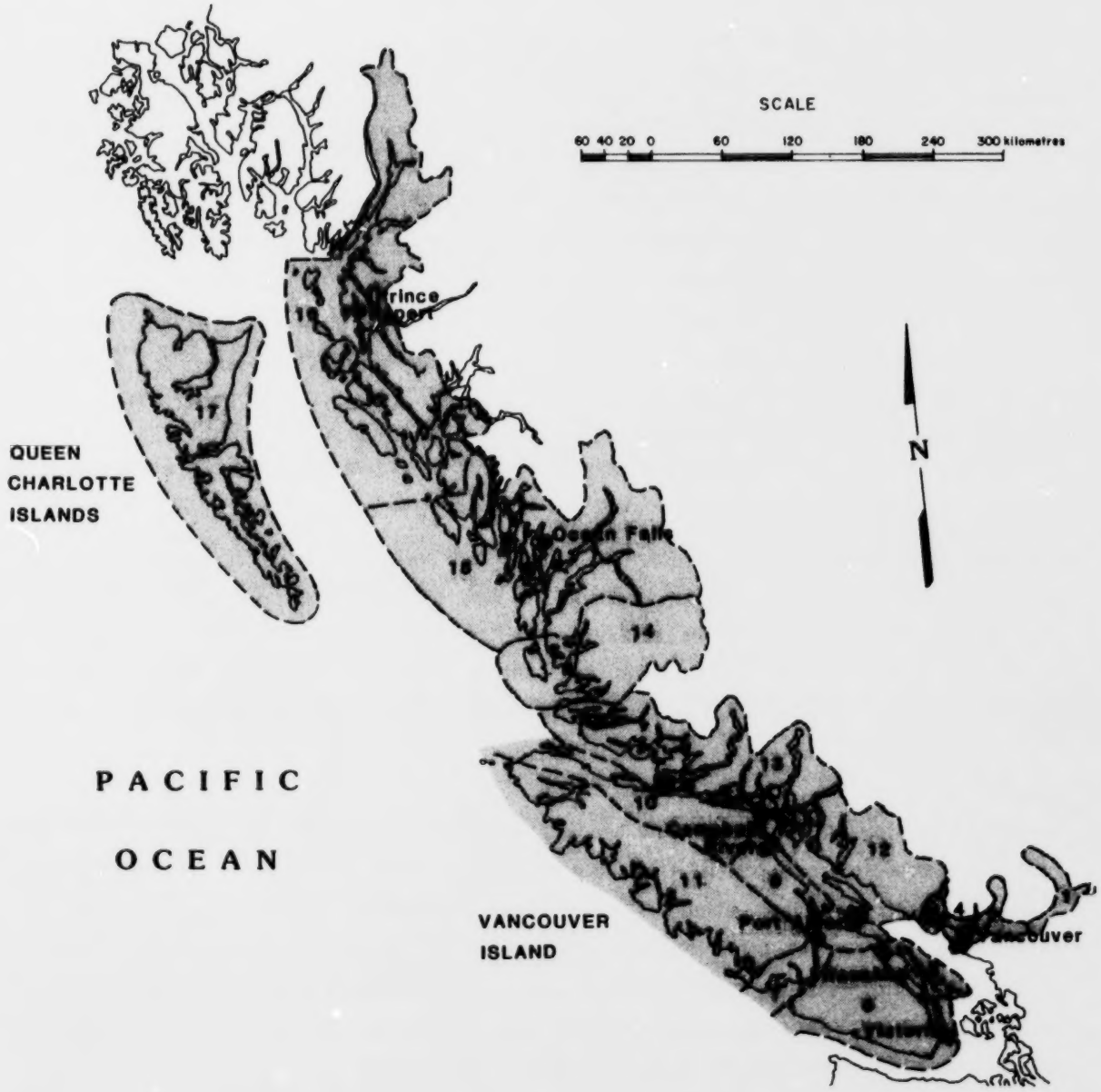
Present and Projected Foreshore Lease Requirements for Coastal British Columbia, 1979

| Region (See figure 1) | Present Leases | | | Projected Lease Area to Year 2000 (ha) | | | |
|---|---|---|---|---|---|---|---|
| | No. of Leases | Volumes Dumped/yr. (1000 $m^3$) | 1979 Lease Area (ha) | Retained Lease Area | Additional New Lease Areas | Total Lease Area | Net Change |
| 1 | 18 | 851 | 135 | 135 | 18 | 153 | 18 |
| 2 | 151 | 1815 | 760 | 716 | 94 | 810 | 50 |
| 3 | 20 | 5 | 107 | 107 | 24 | 131 | 24 |
| 4 | 145 | 123 | 474 | 446 | 66 | 512 | 38 |
| 5 | 75 | 2107 | 851 | 660 | 156 | 816 | (35) |
| 6 | 32 | 1198 | 167 | 162 | 19 | 181 | 14 |
| 7 | 52 | 2797 | 813 | 762 | 26 | 788 | (25) |
| 8 | 64 | 3321 | 1076 | 1051 | 265 | 1316 | 240 |
| 9 | 19 | 1476 | 359 | 312 | 32 | 344 | (15) |
| 10 | 21 | 4070 | 293 | 275 | 36 | 311 | 18 |
| 11 | 109 | 5560 | 1454 | 1330 | 576 | 1906 | 452 |
| 12 | 94 | 4740 | 999 | 831 | 329 | 1160 | 161 |
| 13 | 63 | 3186 | 335 | 168 | 502 | 670 | 335 |
| 14 | 5 | 433 | 38 | 29 | 113 | 142 | 104 |
| 15 | 8 | 593 | 162 | 48 | 150 | 198 | 36 |
| 16 | 37 | 1430 | 481 | 397 | 420 | 817 | 336 |
| 17 | 30 | 2879 | 453 | 347 | 204 | 551 | 98 |
| TOTAL | 943 | 36584 | 8957 | 7776 | 3030 | 10806 | 1849 |

SOURCE: After F.E.R.I.C., 1980 - Compilation and Summary of the Results of the COFI Questionnaires on Logging Use of Foreshore Leases on the Coast of British Columbia.

NOTE: A questionnaire Survey responded to by 187 companies which hold 85% of all coastal foreshore and water lot leases issued for log handling activities.

**Figure 1: Regions Used in the FERIC Study of Foreshore Leases**



intermittent operations and the start-up of new areas of activity. Leases are not necessarily in continuous use at all times. While some existing leases may be abandoned the spreading out of operations may result in a net overall increase in foreshore lease requirements. The statistics presented in Table 2 reflect voluntary reductions in existing leases, rather than any forced reduction in leases caused by pressure from other resource users.

Dumping

Logs are transferred from the land to water in various ways including lift-and-lower, marine rail, log skid and mobile loader systems. Of the total volume 69% is dumped in bundled form. All log dump sites reported in the survey occupy slightly over 200 hectares of water on the entire B.C. coast, which represents about 2.3 percent of the total area of all log handling and storage lease areas. About 46 percent of the coastal log volume is currently dumped by some form of fully controlled system such as a lift-and-lower or marine rail system, whereas 47 percent of the coastal log volume still enters the water by some form of skid system although use of this latter system is declining. Helicopter dumping and other free fall systems account for the remaining seven percent.

Sorting

Logs are sorted by grade, species and size either on land or in water. The amount of sorting completed near a dump depends on the size of the operation. Large volumes of logs are needed to sustain an economic sorting operation, thus logs from smaller operations may first be transported to central sorting grounds. Sorting in water commonly involves pushing logs or bundles into a pocket with a log dozer. Other systems such as floating sort stations have been introduced.

When sorting on land, front-end loaders, log stackers and cranes separate the logs into the various sort categories. Despite greater cost, over 60 percent of the coastal log volume is now being sorted on land. This percentage is increasing, but a lack of available, suitable land areas at most existing concentrations of log handling activity limits opportunities to introduce dryland sorting operations, particularly in the more urbanized areas of southern Vancouver Island and the lower mainland. Topographic constraints in other areas will also require the continuation of water sorting.

## Storage

About 65 percent of all water lease areas used by the coastal forest industry are for log storage. Although the industry is attempting to minimize all log inventories for economic reasons, watered inventories remain large and vary from 5 to 8 million cubic metres. These volumes are required to: balance seasonal logging patterns with constant mill consumption; store species or grades that are temporarily surplus because of market conditions; provide in-transit and safety stock so that consuming mills can operate without interruption; and facilitate open market log sales or trading activities.

Water storage requires sheltered water to minimize buffeting and damage to booms. Deep sheltered water as close as possible to converting plants is preferred by most companies within the industry. Low salinity storage areas are required for long term storage to minimize losses resulting from wood-boring teredos and crustaceans. In many instances shallow and medium depth estuaries are the only areas that are sheltered, have low salinity and are adjacent to existing mills.

Land storage is not a practical solution for most mills located on the coast of British Columbia. Often there is insufficient land area adjacent to the mill for storage. If land is available it is extremely expensive on the southern coast. Moreover, there are larger capital costs associated with high density log storage equipment and the majority of existing mills are designed to receive logs from the water.

## Transportation

There are three principal methods of moving logs along the coast: flat rafts, bundle booms and log barges. Logs may be made into flat rafts or bundle booms to transport camp-run logs to sorting grounds and to take sorted logs to conversion plants. Bundle booms are generally constructed for tows of 40 km or longer while flat rafts are used for shorter distances in sheltered waters. Bundle booms have become the dominant method of transport primarily for three reasons: tow volumes may be doubled; they prevent logs

from escaping or sinking; and they require less storage area. Log barges, which require major capital investments, are usually used to haul large volumes from isolated camps through unprotected waters. Logs are usually loaded by on-board cranes, with logs either loose or bundled. Bundles are preferred to reduce loading time and to minimize log sinkage and breakage. Loading and unloading normally takes place in sheltered waters near storage sites.

## E. INTERACTION BETWEEN LOG HANDLING AND TRANSPORTATION AND THE ENVIRONMENT

Coastal waters link most of the existing mills with harvest areas located on the rugged coast and islands of British Columbia. Log handling is critically dependent upon sheltered areas with adequate water depths, sufficient surface areas, minimal tidal currents, low salinity water and access to deep water. As such, the coastal industry must retain most of its existing leases and acquire new leases in developing areas in order to remain competitive in world markets. Yet, these lease areas involve the tidal reaches of rivers, estuaries, wetlands, intertidal zones and coastal zones - virtually all of which are highly productive environments. They support commercially and recreationally important aquatic resources and provide a vital component for restoration and enhancement of many species.

Log handling operations can effectively take environmental considerations into account both in design and operation. The coastal forest industry has developed and is implementing a number of procedures which reduce the impact of their operations on the environment. However, there is a wide range of other factors that have an impact on the nearshore environment. It is generally recognized that over exploitation, urban and industrial effluent, and foreshore development are but a few of the factors that can lead to degradation of the aquatic environment and its related productivity.

### Impacts

The most profound environmental impacts of log handling are associated with dumping, sorting and storage, especially when these activities occur in intertidal areas or shallow water. Log dumping results in the introduction of bark and wood debris which can accumulate and physically smother marine organisms and their habitats. The decomposition of accumulated bark and wood releases wood leachate which reacts with the available oxygen further impairing the natural productivity of the environment. The

effect of the toxic wood leachates produced under certain conditions in aquatic environments has not been completely documented. The extent and degree of these chemical impacts varies with flushing. Where these log handling activities occur in shallow waters and intertidal areas, marine plant and animal communities may be affected by shading or physical disruption. In some cases, the damage may be irreparable and in others there may be opportunities for restoration depending on the degree of damage and the sensitivity and recoverability of the environments affected.

The degree of impact on benthic and intertidal invertebrates is largely determined by the size of the log handling operation, the handling methods used, the location with respect to sensitive areas, and the ecological, commercial, and recreational importance of affected resources. The most significant adverse impacts of log handling activities on marine benthic invertebrates are the destruction of habitat, and the alteration of benthic infauna habitat and abundance due to wood bark and debris.

Some benthic invertebrate species are beneficially affected by log handling activities. These are primarily epibenthic organisms (wood boring bivalves, isopods, barnacles, tunicates, shrimp). Some of these invertebrates are important fish food organisms. However the creation of habitat for wood boring invertebrates has an adverse affect on the forest industry.

The loss of shallow water and intertidal habitats that are utilized by fish and shellfish is documented. Little quantitative information is available concerning the effects of these losses on rearing juvenile salmonids, herring and other species.

Effects of log handling on shellfish are substantial. Oysters, clams, geoducks and other shellfish are susceptible to bark and debris from log dumping, storage and retrieval sites. Mariculture industries are also subject to significant physical disruption from log handling operations, especially in the intertidal zone.

The impacts of log handling on marine mammals generally are considered minor. Some positive impacts include provision of haul-out areas for otters, seals, and sea-lions. Adverse impacts can stem from changes in the abundance and types of food organisms and from human disturbances. There appear to be no data deficiencies considered serious enough to hamper the assessment of impacts of log handling on marine mammals, with the exception of killer whales where little is known about interrelationships.

The major adverse impacts of log handling on birds stem from localized disturbances associated with human activity, habitat alteration (or alienation) and changes in prey availability. Site specific impacts of log handling on aquatic birds can be very significant - especially if the areas affected are high quality habitat and/or scarce in the region. These potential conflicts between log storage and bird use in estuaries are poorly understood which seriously limits impact assessment. In some situations, positive impacts occur where coastal shores "littered" with debris from log handling and transport losses are resting areas for birds.

The water transportation of logs does not create environmental problems directly. However log losses during transportation contribute to the debris problem. These losses are being reduced through increased use of bundled booms and barges.

Industry Trends and Considerations

Historically, access to a timber supply and suitable shore characteristics were the primary criteria used in determining the location of log handling facilities. As environmental factors were not then perceived to be as important as they are today, they were seldom considered in the design and operation of the facilities. Consequently, these operations often created the environmental impacts noted in the previous section.

In recent years the industry has increased the use of dryland sorts, controlled dumps, deep water sorting and storage, and bundled booms. All of these innovations reduce the amount of bark and debris that can accumulate and consequently the physical and chemical effects associated with their accumulations. In addition, bundling decreases log losses and the surface area required for storage. Even with these changes there remain older facilities which create problems.

Most of the forest companies are establishing dryland sorting facilities at their camps as well as central dryland sorts. These operations decrease the total area required for sorting large volumes of logs and retain the debris on the land. Further, with the trend to bundled booms, companies can store more logs in deeper water. These trends will continue to alleviate environmental disruption.

Even though the industry is becoming more environmentally conscious there are still some trade-off issues that need to be addressed. The industry will continue to rely upon the use of foreshore areas and sheltered waters. Decisions to realize environmental benefits through reducing the size and number of foreshore leases must recognize the associated economic costs. These reductions affect harvesting patterns, operating costs and employment opportunities throughout the industry and within individual companies.

In reviewing any impact on industry, the implications related to both alternative operating methods and locations must also be assessed. In many cases the forest industry does not have feasible alternate sites available. Also, a decision on a specific area can significantly affect the total log flow pattern. For example, insufficient area for storage of the required inventory means that additional storage must be found or that log volume shipped to that mill must be reduced or stored at the point of origin. Due to the complexity of the log flow system between timber supply areas and converting facilities, decisions regarding log handling facilities cannot be made without recognition of the entire system.

In the past, log handling facilities were considered solely in relation to harvesting of old growth timber. It has been the practise to retain a foreshore lease only for the time harvesting takes place. Consideration must be given to the concept of maintaining foreshore areas over a rotation period. Foreshore areas may be required intermittently after initial logging is completed. Intensive forest management activities such as commercial thinning may require log handling facilities. Also, the second and subsequent harvests will, in all probability, require some form of foreshore use. Due to long periods of inactivity, other uses may be considered at these sites when not in use by the forest industry.

Even though the relationships between log handling and transportation and the environment have been generally defined the Committee considers it too simplistic to take a position that the forest industry must avoid or remove its operations from all sensitive areas. As mentioned earlier, the industry is dependent on areas where it has the potential to reduce environmental values. Furthermore, there are projections for increases in the forest industry's need for sheltered waters and shore areas. Thus, even though increased industry attention is being given to move to deep water and to apply new technology to present and future operations, limits will be reached and a balancing of benefits from various uses will be required to allocate shore areas.

This situation of conflicting dependencies and adverse relationships requires that the industry continue to develop technologies and adjust operational procedures both on a coast wide, coordinated industry basis and on a site specific basis, to reduce the environmental impact of activities. At the same time other users must adopt an attitude that recognizes the forest industry's dependence upon coastal log handling and transportation. This challenge is addressed in the concluding sections of this report.

## F. RECREATION INTERACTIONS

The south coast of British Columbia is considered to be one of North America's finest shore ano open water recreation areas. Opportunities for beachcombing, recreational lodging, swimming, diving and numerous other shore-based recreational activites abound. However, there is a substantial lack of specific information which documents the activities or the potential of this use of the resource. Information on the present extent of open water recreational activities has been better documented. B.C. has the highest rate of boat ownership in Canada with over 2.2 million boat days of use occurring on the Strait of Georgia in 1978, over 1.0 million days of which were spent sport fishing.

There are numerous examples of compatibility between boaters and the log handling industry. In areas where there are limited natural anchorages, recreational boats, especially transient pleasure craft, take advantage of log booms and forest industry facilities such as wharves and floats for temporary moorage along routes to favored destinations. Some of the sheltered sites used by the log handling industry will also increase in value as potential permanent marina sites, especially in the high-demand, heavily populated south coast areas. This results in pressure on the industry to reduce its present use of shore by selecting alternative sites, by altering operational procedures or by applying new log handling technologies. Similarly, increased industrial alienation of shores which are suitable for recreational housing and other recreational activities, may also result in pressure on the industry either to reduce its present use of such shores or to select alternate sites, should any be available.

The presence of loose logs and associated debris, which has historically been the major log handling and transportation related problem for boaters, has been reduced by increased dryland log sorting, bundle booming and barge transportation of logs. This, together with other programs such as salvage operations and the Fraser River debris collection facility, have contributed to a substantial reduction of floating debris. However, because of increasng numbers of boaters in the Georgia Strait area, such reductions in debris will not necessarily reduce the incidence of collisons and damage, so it is likely that continued concern will be voiced by the boating public and their associations.

More attention must be given to long range recreational requirements of shore use in decision-making on both new foreshore lease applications, and the renewal of existing ones. In the heavily used Georgia Strait, Howe Sound and Fraser River areas where there is a greater potential for conflict, there is a need for monitoring of recreation and forest industry relationships.

## G. REGULATION

The effect of government regulation on the private sector is an ongoing concern. On one hand, government has a responsibility to ensure that public interests in the use of resources are adequately protected. On the other hand, industry must maintain attractive investment opportunities by being able to sell its products competitively and profitably on world markets. Increased government involvement in regulating resource uses reflects pressures from population growth, competition for limited resources, and concern for maintenance of ecosystem productivities. The prevailing question raised by industry, government and the public is whether the most equitable socio-economic balance is being maintained.

A large number of statutes, administered by a variety of agencies of the federal, provincial and local governments influence the allocation and management of coastal lands and waters. Prime among these are the provincial Land Act and the Canada Fisheries Act. Given the diversity of interests, agencies and regulatory devices, and the state of the information base, the protection of estuarine and nearshore marine ecosystems has been described by Westwater Research Centre* as a 'regulatory bargaining process', which endeavors to balance government's regulatory powers with the political and economic powers of the private sector and with the concerns of the public.

Several shortcomings were identified by Westwater with respect to the allocation and management of shores and adjacent waters. These include the need for improving the information base, introducing long range planning for individual uses, determining methods for deciding between uses, and ensuring accountability of the various participants in the decision-making process.

* University of British Columbia, Westwater Research Centre. Salmon Protection and the British Columbia Coastal Forest Industry: Environmental Regulation as a Bargaining Process. Vancouver, Dorcey, Anthony, H.J., McPhee, Michael W. and Sydneysmith, Sam. 1980.

The analysis of log handling, environmental and recreational interactions imply that decisions affecting the siting or design of log handling facilities should err on the side of environmental protection. In the absence of answers to questions such as how much productivity is lost through any ecosystem damage or the extent of the impact on the forest industry,the decision in the final analysis is necessarily a value judgement, with associated risk and error.

To provide a systematic approach to decision-making, the Ministry of Lands Parks and Housing has introduced two sets of procedures, the "Interim Guidelines for Review and Processing of Coastal Log Handling Applications" and a "Framework for Foreshore Administration".

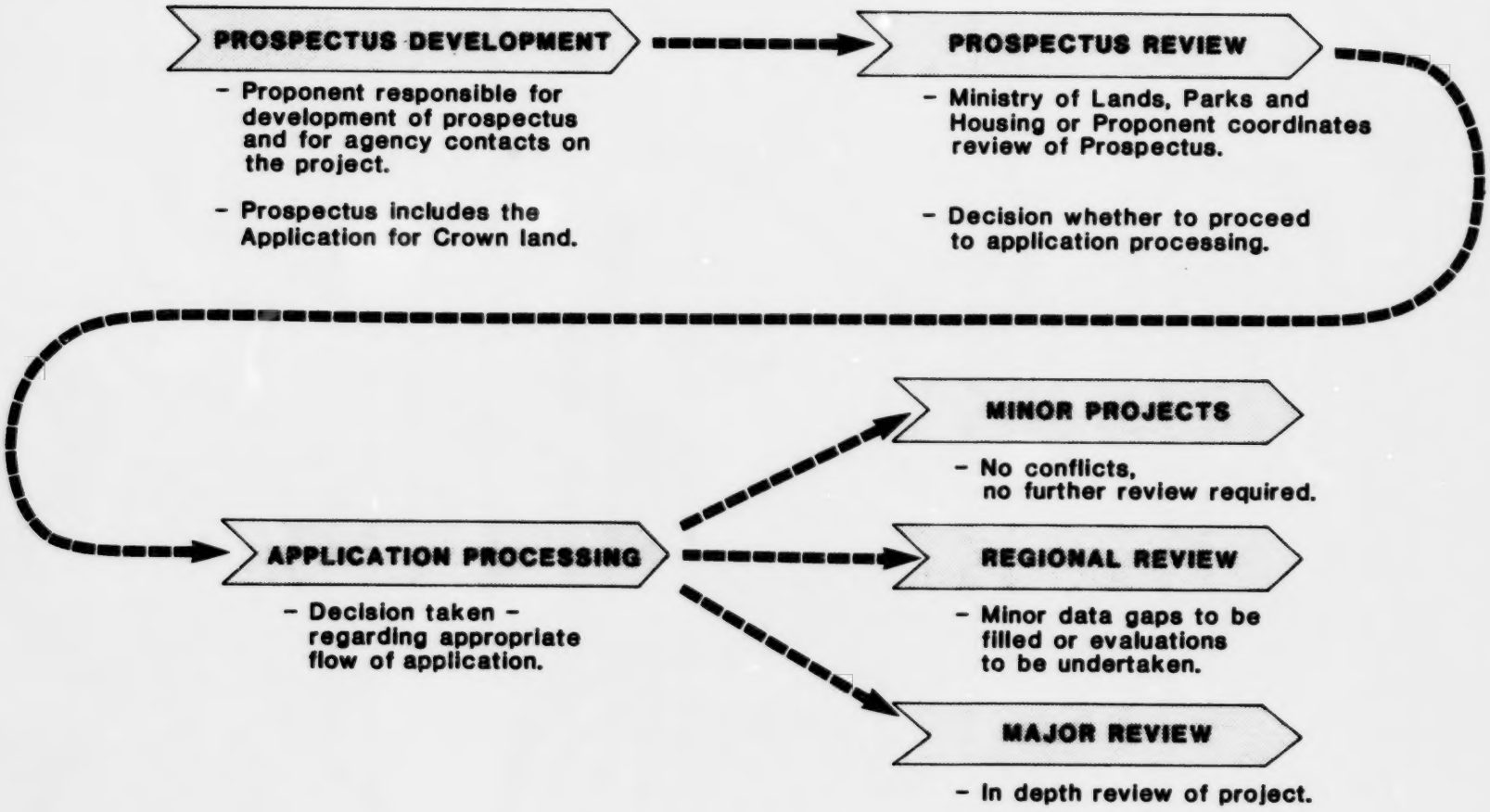
The Guidelines process which is illustrated in Figure 2 was developed in consultation with industry and federal and provincial government agencies to ensure that decisions not only consider, but indeed move towards optimizing the environmental social and economic benefits in as sensitive, efficient and responsible manner as possible.

The draft report "Framework for Foreshore Administration" is a strategy for long range planning which suggests an approach for establishing long term requirements for coastal zone resources, evaluating capabilities and balancing benefits to society. This approach involves identifying areas essential to the maintainance of specific activities, determining resource production objectives for regions and specific areas, making choices about prime and other uses, and allocating and managing on the basis of a strategic plan designed to achieve agreed objectives.

These assessment and planning approaches, designed to aid in making decisions, have in the case of the Interim Guidelines only been tested for a year, and in the case of the Framework has not been fully discussed. Both of these documents, together with further refinement with reference to this report, present a potential for greatly improving the way in which government, industry and the public seek an equitable socio-economic balance among competing uses of our coastal shores and adjacent waters.

FIGURE 2

## GENERALIZED FLOW
## LOG-HANDLING APPLICATION REVIEW PROCESS


PROSPECTUS DEVELOPMENT
- Proponent responsible for development of prospectus and for agency contacts on the project.
- Prospectus includes the Application for Crown land.
PROSPECTUS REVIEW
- Ministry of Lands, Parks and Housing or Proponent coordinates review of Prospectus.
- Decision whether to proceed to application processing.
APPLICATION PROCESSING
- Decision taken - regarding appropriate flow of application.
MINOR PROJECTS
- No conflicts, no further review required.
REGIONAL REVIEW
- Minor data gaps to be filled or evaluations to be undertaken.
MAJOR REVIEW
- In depth review of project.

## H. CONCLUSIONS

While detailed direction has not been forthcoming from the overall examination of log handling and transportation interrelationships, several consistent themes have emerged and these provide a strong basis for action:

1. The Committee recognizes many coastal shores and waters, particularly estuaries, as being highly productive for many species of plants and animals and essential to the life cycle of most commercial and recreational fish species.

2. The Committee similarly recognizes the use of coastal shores and waters including some estuarine areas as being essential to the operation of the forest industry and supportive of its competitive position. The industry must continue to use these waters for its log handling and transportation activities.

3. Coastal shores and waters including estuaries provide essential wintering and staging habitat for large numbers of waterfowl shore birds and migrants on the Pacific Flyway. In addition it provides important habitat for resident birds.

4. Southern coastal shores and waters receive heavy recreation use and demand for this use is increasing throughout the coast.

5. Estuaries and nearshore areas are rich and complex ecosystems which are susceptible to varying degrees of physical, chemical and biological alteration as a result of log handling activities.

6. Interactions between log handling activities and ecosystems, may or may not be significant on a regional scale, but can result in major ecological changes to specific sites. Where activities are concentrated, or where environments have unique features or a high potential for other uses, log handling impacts are often perceived to be major and deserving of removal or mitigative action. When assessing the impacts in these cases, consideration must be given to the availability of alternatives and the relative costs and benefits associated with mitigative designs and operational practices.

7. Log handling and transportation technology has improved to the point where the degree of physical change to the environment is being substantially reduced.

8. Existing information indicates that the industry is not in a position to reduce its use of coastal waters. The projected demand for this use is growing. Hence there is a need for industry to continue to develop technologies and adjust operational procedures both on a site specific and coast wide, coordinated industry basis.

9. Prior to the use of the "Interim Guidelines for the Review and Processing of Coastal Log Handling Applications", the planning and review process for assessing the location and design of log handling facilities and operations was not clearly defined.

10. In the absence of coastal strategic plans, new facilities have been located or designed without adequate reference to all other uses and their interactions.

11. Existing biological data are inadequate to make fully informed decisions in all but the most well-defined cases of interactions. As a result, developments can be subject to restrictions in the absence of quantitative data.

12. The competition for use of the limited supply of readily accessible, biologically productive and recreationally attractive foreshore areas in coastal B.C. is clearly a growing concern. A cooperative and coordinated approach is essential to meet the interests of all coastal users.

13. More information is required to quantify the significance of fish habitat losses in estuaries and foreshores on the productivity of commercially and recreationally important fish species and stocks.

## I. RECOMMENDATIONS

In response to these basic conclusions and to the more detailed conclusions and recommendations contained in the background reports, the Steering Committee recommends the following actions be taken by appropriate government agencies and the industry.

1. Government must undertake long range strategic planning for the coastal zone. This will involve:
   - the analysis of coastal lands, waters and other resources and the demand for these;
   - the analysis of alternative land and water uses and the management of related coastal resources; and
   - the evaluation of relative benefits of these alternatives to society.

   This planning context should be used as the basis for assessing the acceptability of current and proposed uses.

2. Decisions on the location, design and operation of a new log handling facility and, if warranted for the renewal of existing leases, should consider the following:
   - operational suitability;
   - direct financial feasibility of an operation;
   - biological and physical consequence, both positive and negative, of alternatives;
   - social (public) acceptability;
   - availability of reasonable alternatives;
   - equity (application of due process to alternative or competing uses);
   - aesthetics and recreation;
   - rehabilitation with reference to environmental conditions, use and duration;
   - regional as well as local considerations; and
   - possible compromises or trade-offs to achieve optimal overall results.

3. The forest industry should continue its current trends in the following operational areas:
   - to use dryland sorting techniques;
   - to bundle logs for transportation and storage;
   - to transport logs by bundle boom or barge;
   - to use deep water wherever possible for log handling and storage;
   - to avoid damage to sensitive estuarine and nearshore marine areas and shores;

- to use controlled dumping systems; and
- to contain and recover floating debris.

While all of these actions are consistent with trends already well underway in the industry, all segments of the industry must accept the need to develop and use new technology.

4. The forest industry should study the feasibility of a coordinated approach to log handling operations on a coast wide basis.

5. Programs should be developed and implemented to foster greater environmental awareness and improved practices at all levels of the forest industry and government. This should involve close cooperation between these groups and the public.

6. Government decision making with respect to coastal land and water uses and the management of resources should involve the public.

7. A comprehensive research program should be implemented to provide additional knowledge on the physical environment, biological productivity and relationships in shore zone and estuarine habitats and assess opportunities for restoration development of those habitats.

8. Biophysical research should seek to quantify and assess the significance of the impact of log handling activities on fish and wildlife habitats in shore zones and estuaries and the effect of these impacts on specific populations.

9. The Interim Guidelines for the Review and Processing of Coastal Log Handling Applications, should be finalized after revision on the basis of the foregoing recommendations, the background reports and any comments received from interested parties. Monitoring of the use of the guidelines should continue.

10. A Committee should now be formed to discuss and define specific follow-up actions, to recommend these to appropriate agencies for action and to monitor the implementation of these actions. The Committee should comprise representatives of the provincial Ministries of Lands, Parks and Housing; Forests; and Environment; the federal Departments of Fisheries and Oceans and of the Environment; the Council of Forest Industries; a representative of the academic community; and a representative of concerned public interest groups.

## GLOSSARY

| | |
|---|---|
| Anadromous: | - an animal which spends a portion of its life cycle in the sea and returns to fresh water to spawn. |
| Benthic: | - plants and animals living on or in the bottom of a body of water. |
| Biophysical: | - the combined biological and physical characteristics or functions of a resource or area. |
| Bundle Boom: | - logs strapped together by either cable or steel strapping; a number of bundles would be formed into a boom. |
| Camp run logs: | - unsorted logs which are often of mixed species; they may be either bundle boomed or flat rafted. |
| Deep water storage: | - log storage areas in which the logs remain completely floating at low tide. |
| Environmental Impact: | - the effects of an activity upon a resource or the environment. |
| Eelgrass: | - an annual seagrass that grows on intertidal and shallow areas of estuaries and other foreshore areas; eelgrass beds provide food and protection for a wide variety of marine organisms. |
| Estuary: | - a semi-enclosed body of water having a free connection with the open sea and within which the sea water is measurably diluted with fresh water drained from the land. |
| Flat raft: | - a log boom made up of a single layer of loose logs. |
| Foreshore: | - this term is used in a general manner to mean both intertidal and subtidal lands, rather than in a technical sense which would refer only to lands between the mean high and low water marks. |
| Foreshore leases | -this term is used to mean any from of tenure issued under the Land Act, by Harbor Commissions or private owners. |

| | |
|---|---|
| Habitat: | - the natural living environment of animals and plants. |
| Invertebrate: | - an animal not having a backbone. |
| Leachate: | - the water soluble components of wood. |
| Log consumption: | - the primary processing of logs at mills. |
| Log dumping: | - placing of either loose or bundled logs in water. |
| Log handling: | - one or more activities such as dumping, booming, sorting and storage. |
| Log production: | - the harvesting of trees for consumption. |
| Log sorting: | - the separation of logs by size, grade and species either on dry land or in the water. |
| Log storage: | - the holding of log booms in water or loose logs on land. |
| Mariculture: | - an operation for the growing and harvesting of marine plants or animals. |
| Mitigation: | - an action to avoid or make less severe an impact. |
| Pelagic: | - relating to, living, or occurring in the open sea. |
| Safety stock | - the component of inventory that provides a buffer against the risk of log production being below forecast. |
| Sessile: | - permanently attached, not free to move about. |
| Strategic Planing: | - planning undertaken at a broad regional level dealing with supply and demand analysis leading to priorities for resource management opportunities based on production targets over a fixed period. |
| Substrate: | - any solid surface or substance which forms the place of attachment or dwelling for a plant or animal. |
| Teredos: | - a type of marine clam that bores into and feeds on wood, causing extensive damage to logs stored in marine waters. |

## APPENDIX I

## STEERING COMMITTEE AND REVIEW

## PANEL MEMBERSHIPS

### STEERING COMMITTEE

| | |
|---|---|
| Chairman | R.A. Shebbeare (Council of Forest Industries) |
| Members (federal government) | |
| Dept. of Fisheries and Oceans | F.C. Boyd |
| Dept. of Environment | W.F. Sinclair |
| Members (provincial government) | |
| Min. of Environment | J.P. Secter (alternate - W.B. Morgan) |
| Min. of Forests | R.B. Addison (alternate - W.G. Swanson) |
| Min. of Lands, Parks & Housing | G. Roberts (alternate - T.C. Cockburn) |
| Members (COFI) | |
| Crown Zellerbach | P. Oakley |
| MacMillan Bloedel | K.G. Boyd (until February 1980)<br>R.E. Urban (from February 1980) |
| Pacific Forest Products | I. MacRae |
| Special Advisors | E. Karlsen (Min. of Municipal Affairs, formerly with E.L.U.C. Secretariat)<br>R.E. Urban (until February 1980) |
| Secretary | P.G. Gilbert (Council of Forest Industries) |

## REVIEW PANELS

| | |
|---|---|
| **Environmental Review Panel:** | N.J. Wilimovsky, Chairman<br>V.C. Brink<br>G.H. Geen<br>T.R. Parsons<br>D.B. Quayle |
| **Log Handling Review Panel:** | S. Techy, Chairman<br>K.G. Boyd<br>D.M. Lawrie<br>P. Oakley<br>O.R. Travers<br>G.V. Wellburn |
| **Recreation Review Panel:** | H.J. Block, Chairman<br>A.D. Chambers<br>I. MacRae |

## APPENDIX II

## TERMS OF REFERENCE

The following original Terms of Reference for the study were approved in June, 1979, by representatives of the federal government, the provincial government and the Council of Forest Industries of B.C.

### PHASE I

#### I.1 Log Watering and Transport Component

I.1.1. Prepare a forest industry status and forecast report, focussing on the handling, watering, transport and storage of logs on the British Columbia coast. Data to be presented for the years 1980 and 2000, including but not necessarily limited to the following:

- log flow and inventory volume data
- water acreage requirements for dumping, sorting, booming, storage and towboat reserves (normal and peak levels)
- coastal acreage requirements for dumping (including dumps used only intermittently through a forest rotation period)

I.1.2. Idenfity and discuss alternative modes and systems for the handling, storage and transportation of logs, both in the water and out of the water.

I.1.3. Identify physical and operational constraints to various log handling, storage and transportation methods.

I.1.4. Analyze the relative economics, in terms of comparative costs of the various options identified in sections I.1.2. and I.1.3. above.

I.1.5. Identify, analyze and priorize relevant data gaps.

#### I.2. Environmental Component

I.2.1. Review the present data base for estuaries and near-shore marine systems of British Columbia, with reference where relevant and/or necessary to other areas on the northwest coast of North America, focussing on ecosystem structure, process and use.

I.2.2. Identify, analyze and priorize relevant data gaps.

I.3 Recreation Component

I.3.1. Define the coastal water-oriented recreation resource base and its uses including any direct or indirect recreational involvement.

I.3.2. Prepare a status report on past, present and future trends in the recreational use of estuarine, near-shore and open water systems, with consideration for the directly affected fresh water systems and lands.

I.3.3. Identify, analyze and priorize relevant data gaps.

I.4. Regulatory and Evaluative

I.4.1. Review the administrative structure for management of estuaries, foreshores and near-shore marine areas in British Columbia, focussing on government responsibilities.

I.4.2. Identify and discuss the economic aspects of ubiquitous biotic resources, of ecological systems integrity, and of intangible (non-market) environmental factors relative to economic methods employed to evaluate industrial (market) use options.

I.4.3. Identify and discuss the present criteria by which uses of these areas are regulated in British Columbia, with reference to how log handling and transport is regulated in other areas on the Northwest Coast of North America.

I.4.4. Identify the nature and extent of incremental costs of log handling and transport due to compliance with environmental regulations.

PHASE II

II.1 Identify, describe and discuss known and potential types of environmental impacts of log watering and transportation on estuaries, foreshore and near-shore marine systems (and directly-affected fresh-water ecosystems and lands) in terms of structure, process and use (with reference to the component resources therein and the uses thereof).

II.2 Identify, describe and discuss known and potential types of impacts between log handling, watering and transportation and coastal water-oriented recreation.

II.3 Relate the above (I.3.2.) recreational trends to log handling, watering and transportation.

II.4 Describe and priorize areas of investigation required to enhance decision-making related to use of coastal systems for log watering and transportation in relation to potential conflicts with environmental and recreation values.

II.5 Identify and assess the public and private costs of administration of environment and land use regulations affecting log handling and transport.

II.6 Identify and assess the potential of analytical strategies for estimating the benefits from forest industry compliance with environmental and land use regulations.

II.7 Analyze the performance of selected decision-making process for regulating the interface between the environment and log handling and transport.

## III. STUDY MANAGEMENT

The joint program will be managed by a Steering Committee under the Chairmanship of the Council of Forest Industries of B.C. Members of the Steering Committee to be appointed by each participant as follows:

- Council of Forest Industries of B.C.:
  - Chairman and Secretary (2 persons)
- Industry:
  - 3 persons - for the log handling and environmental components
- Provincial Government:
  - 3 persons - for the log handling and environmental components
    (plus, as needed: one person for liaison re recreation
    two persons for liaison re regulatory/
    evaluative)
- Federal Government:
  - 1 or 2 persons from Fisheries and Oceans
  - 1 person from Department of Environment

In addition there will be two positions related to the Steering Committee in an advisory capacity: one from Industry and one from Government.

## IV. PUBLIC INFORMATION

It is intended that when final reports on the study components are produced, these will be available to the public.

## APPENDIX III

## LIST OF REPORTS PREPARED FOR THE STUDY


Environmental Review Panel. Estuary, Foreshore and Water Log Handling and Transportation Study: Overview of the Environmental Component. Vancouver, 1980.

Environmental Sciences Limited and F. F. Slaney & Company Limited. A Review of the Impacts of Log Handling on Coastal Marine Environment and Resources. Prepared for the Environment Review Panel of the COFI/Government Estuary, Foreshore and Water Log Handling and Transportation Study. Vancouver, 1980.

Forest Engineering Research Institute of Canada. Report to COFI Subcommittee on Foreshore & Estuary Use: Evaluation and Economic Analysis of Twenty-Six Log-Sorting Operations on the Coast of British Columbia. Vancouver, Sinclair, A.W.J., 1980.

Forest Engineering Research Institute of Canada. Report to COFI Subcommittee on Foreshore and Estuary Use: Compilation and Summary of the Results of the COFI Questionnaires on Logging Use of Foreshore Leases on the Coast of British Columbia. Vancouver, McDonald, M.J., Sinclair, A.W.J. and Tse, P.P. 1980.

Juan de Fuca Environment Consultants. Recreation Components: British Columbia Esturary, Foreshore and Log Handling Study. Victoria, 1980.

Recreation Review Panel. "Recreation Component-Review Panel Summary". Victoria, 1980 (unpublished).

University of British Columbia, Westwater Research Centre. Salmon Protection and the British Columbia Coastal Forest Industry: Environmental Regulation as a Bargaining Process. Vancouver, Dorcey, Anthony H.J., McPhee, Michael W. and Sydneysmith, Sam. 1980.

## APPENDIX IV

### LIST OF OTHER REPORTS USED BY THE STEERING COMMITTEE

Boyd, Kenneth,G. Water Transport of Wood: B.C. Coast. This paper was presented at the 60th Annual Meeting of the Woodlands Section, Canadian Pulp and Paper Association, Montreal, 1979.

Ministry of Lands, Parks and Housing: Land Use Planning Section Land Programs Branch. Discussion Paper. "Framework for Foreshore Administration". The Ministry of Lands, Parks and Housing's Role in Foreshore Administration. Victoria, 1980.

Ministry of Lands, Parks and Housing: Land Use Planning Section Land Programs Branch. Interim Guidelines for the Review and Processing of Coastal Log-Handling Application. Victoria, 1980.

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